



Mission Research Corporation

RF ATTENUATION TEST

[REDACTED]

HEMP SHIELDED DOORS, OCTOBER 3-4, 1991,

Sanitized Version

A. Thomas Bolt
David A. Schafer

Draft: December 5, 1991
Final: January 23, 1992

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Prepared for:

DIRECTOR
DEFENSE NUCLEAR AGENCY
6801 Telegraph Road
Alexandria, VA 22310-3398

Under DNA Contract:

DNA001-89-C-0022, Work Area 3

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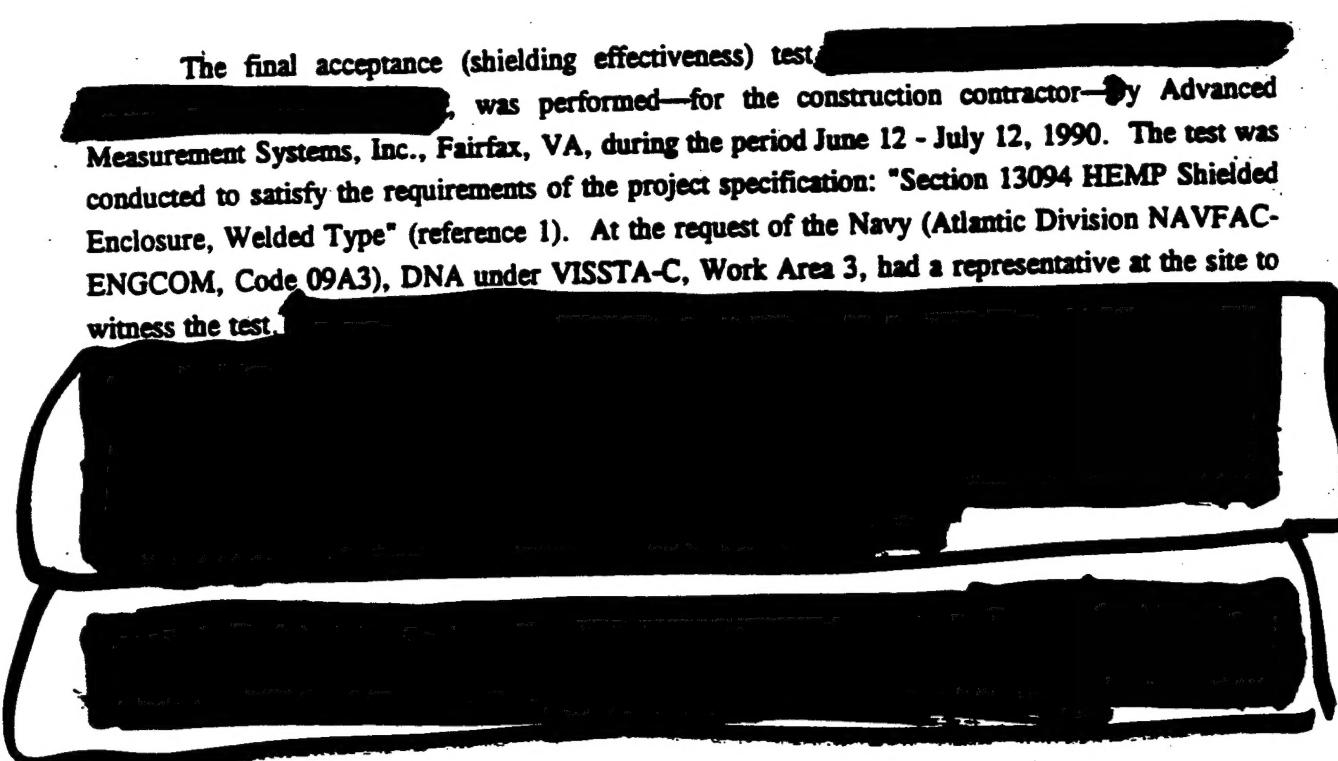
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SECTION 1

INTRODUCTION

1.1 BACKGROUND.

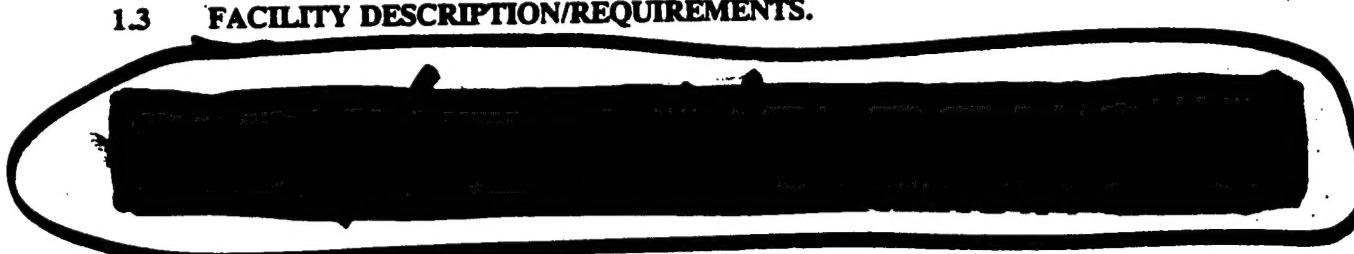
The final acceptance (shielding effectiveness) test [REDACTED] was performed—for the construction contractor—by Advanced Measurement Systems, Inc., Fairfax, VA, during the period June 12 - July 12, 1990. The test was conducted to satisfy the requirements of the project specification: "Section 13094 HEMP Shielded Enclosure, Welded Type" (reference 1). At the request of the Navy (Atlantic Division NAVFAC-ENGC, Code 09A3), DNA under VISSTA-C, Work Area 3, had a representative at the site to witness the test.

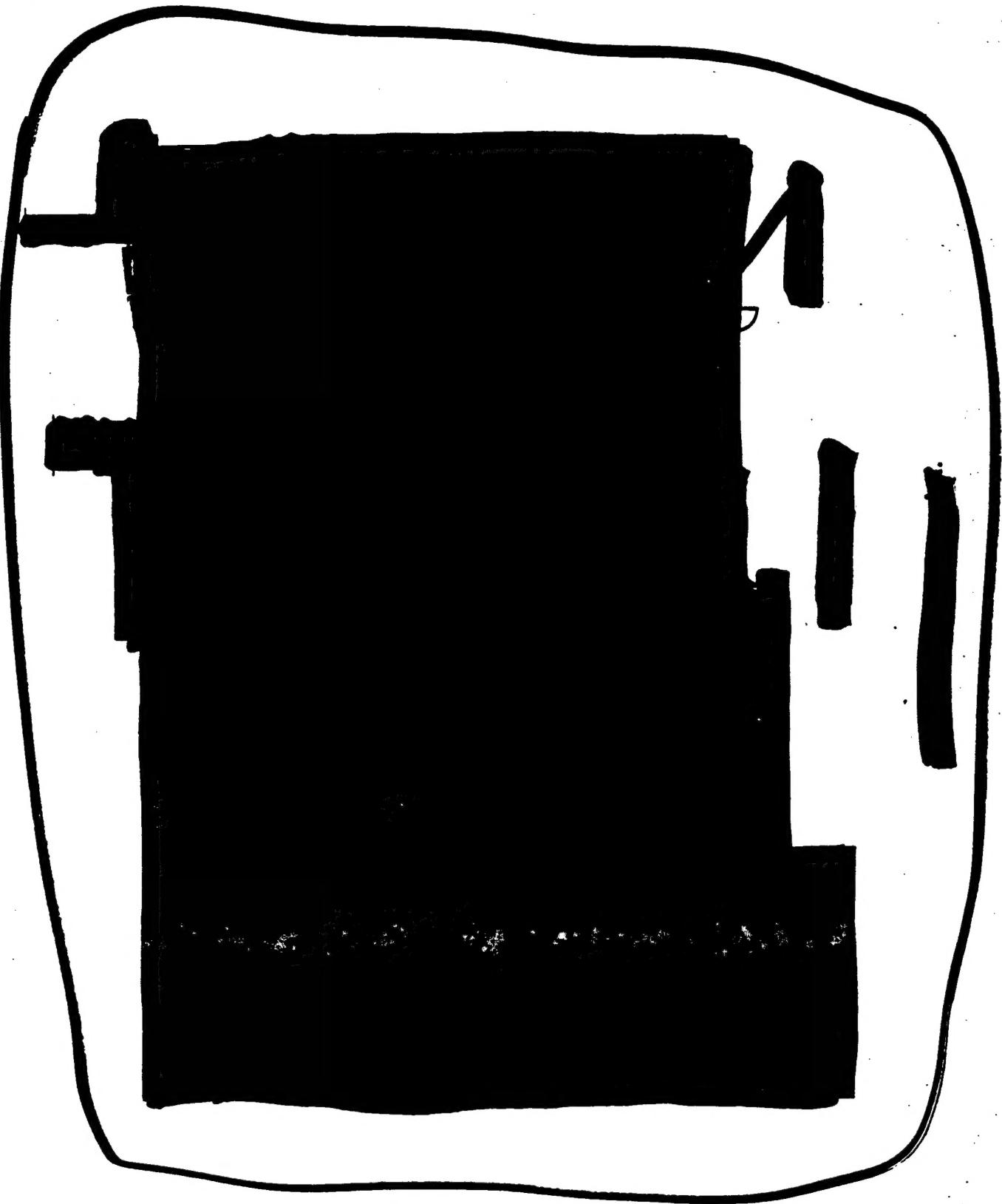


1.2 REQUEST FOR ASSISTANCE.

On September 26, 1991, a phone call was received from [REDACTED] (Atlantic Division NAVFACENGC, Code 09A3), regarding the Navy's desire to have a test performed on the HEMP shielded doors [REDACTED] [REDACTED] (Chesapeake Division, NAVFACENGC, FPO-2 B5) also called regarding the test. The request for the test was coordinated with DNA by [REDACTED]. They also coordinated with the appropriate site and project personnel. The test was scheduled for October 3-4, 1991.

1.3 FACILITY DESCRIPTION/REQUIREMENTS.





Test frequencies and required attenuation, specified in the project specification, are as follows:

<u>Frequency</u>	<u>Attenuation</u>	<u>Field</u>
15 kHz	65 dB	H-field
250 kHz	88 dB	H-field
5 MHz	100 dB	H-field
30 MHz	100 dB	E-field
100 MHz	100 dB	Plane wave
500 MHz	100 dB	Plane wave
1 GHz	100 dB	Plane wave

1.4 SCOPE.

The scope of this test was to measure and report the attenuation of the [REDACTED] installed HEMP shielded doors [REDACTED]. No repairs were to be made. If tests were hampered by unprotected penetrations or if some of the doors did not operate properly, these conditions were to be recorded. Testing was to be performed in accordance with the facility HEMP protection system specification.

1.5 PURPOSE OF TESTS.

The purpose of the door tests was to obtain performance data on the RF attenuation of the installed doors, for use by the Navy.

SECTION 2

DOOR TESTS

2.1 GENERAL.

On October 3, 1991, prior to conducting the tests, the MRC test personnel had informal discussions regarding the planned tests, with [REDACTED] (NAVFAC), the ROICC, the AROICC, and local site personnel. We inspected the [REDACTED]-shielded doors to determine their testability.

[REDACTED]

[REDACTED]

Testing was conducted on October 3-4, 1991. [REDACTED] was the Navy representative and point of contact for these tests. In addition, he witnessed all of the tests.

[REDACTED]

[REDACTED]

2.2 TEST PROCEDURE.

The test setups that were employed are illustrated in figures 2 through 4. There was some variation in the actual test configurations used in each test, to optimize each door test. For example,

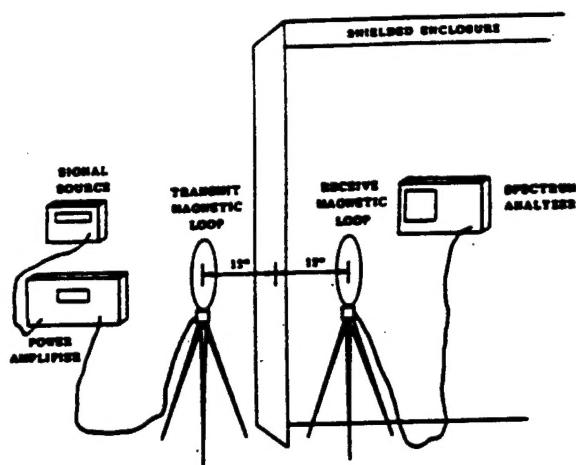


Figure 2. Magnetic field test setup.

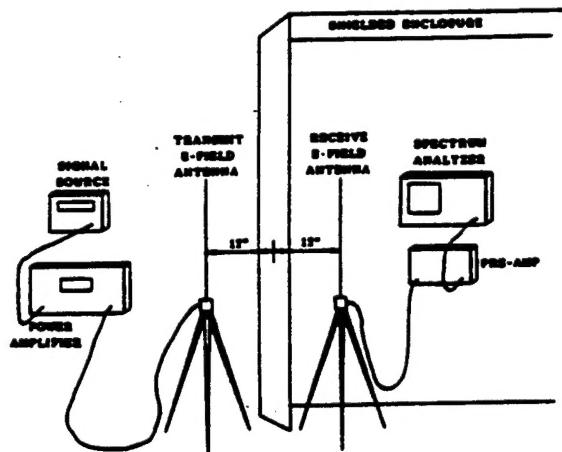


Figure 3. Electric field test setup.

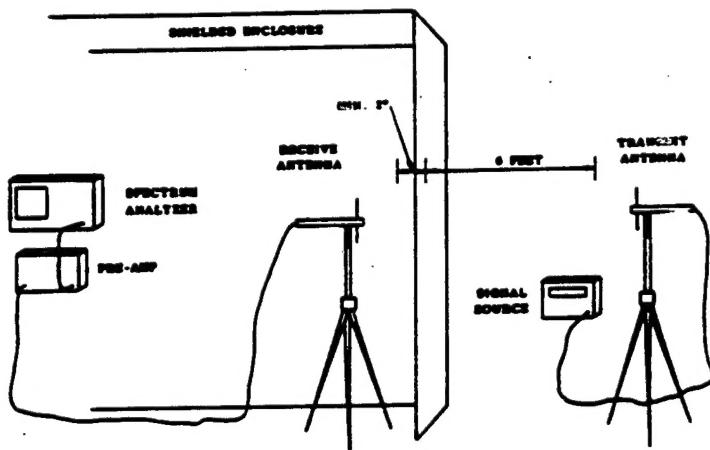


Figure 4. Plane wave test setup.

for some tests it was found that reversing the transmitter and receiver locations provided more reliable results—due to high ambient noise. For some tests, preamplifiers and/or power amplifiers may have been used. Testing was optimized to reflect local conditions. Dynamic range was adjusted to reflect the needs of each test at each test frequency.

Testing was conducted in accordance with modified MIL-STD-285 (reference 3) procedures. Equipment used included the following:

<u>Equipment</u>	<u>Description</u>
HP 8562A	Spectrum Analyzer
Avantek APG-1023M	Preamplifier
Trontech WIG2-M4	Preamplifier
Marconi 2022D	Signal Generator
Solar Model 6552-1A	100 Watt Solid State Audio Amplifier
Antennas	20 inch loops, dipoles, and monopole antennas

2.3 TEST RESULTS.

Attenuation tests were performed on all testable doors without any prior preparation or cleaning. All doors, however, were first inspected to ascertain whether they had any obvious defects or other conditions that might negate the validity of the test results. It was felt that there should be minimum risk if the doors were not first cleaned since the doors were all cleaned and prepped on September 19, 1991, just 14 days prior to the tests reported herein.

The test data sheets appear in Appendix C. Test data are shown to two decimal places, resulting from the digital readings taken directly from the screen of the HP 8562A spectrum analyzer.

Six test points were used for the low frequency magnetic measurements and for the 1 GHz plane wave measurements. Four test points were used for the 30 MHz E-field and the 500 MHz plane wave measurements. The number of test points used reflected antenna size and coverage.

Low frequency magnetic measurements were made with the antennas placed coaxially and positioned vertically. For the general case, the antennas were held in a fixed position. Little sweeping or movement of the receiving antenna was necessary since significant leakage was the normal case. Additional sweeping of the receiving antenna possibly would have resulted in worse leakage.

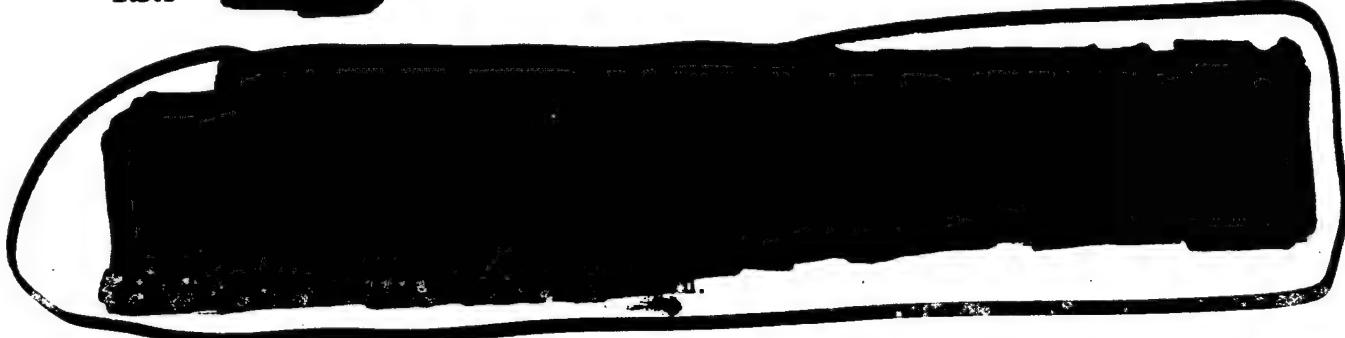
Only one door, Door H1, was tested at 30 MHz E-field. No failure or leakage was experienced. Similar results would be expected for the other doors. Because of limited test time and the unlikelihood of finding any significant leakage at 30 MHz E-field, no other E-field measurements were made.

Only one door was tested at 5 MHz magnetic due to limited test time. The magnetic characteristics of the doors were adequately characterized at 15 kHz and at 250 kHz, so this limitation would not be expected to affect the conclusions reached regarding the performance of the doors.

Because of the size of the 500 MHz dipoles, measurements were made at four points around the doors—parallel with the top and bottom of each door, and parallel to the sides of each door.

For the 1 GHz plane wave measurements, six points around each door were tested. Since cross polarization can be experienced—during door tests—at the higher plane wave frequencies, the receiving antenna was rotated to obtain the worst case reading.

2.3.1 [REDACTED]



Tests were performed at 15 kHz, 250 kHz and 5 MHz magnetic field, 30 MHz E-field, and at 501 MHz and 1 GHz plane wave.



As would be expected, the door passed the 30 MHz E-field test. No leakage signal was seen. It is only on rare occasions that failures are detected via E-field measurements. H-field measurements provide information primarily on the materials used for the barrier components. Plane wave measurements provide information on the as-designed and as-built condition of the barrier and its components.

Attenuation at 501 MHz met the specification requirements.

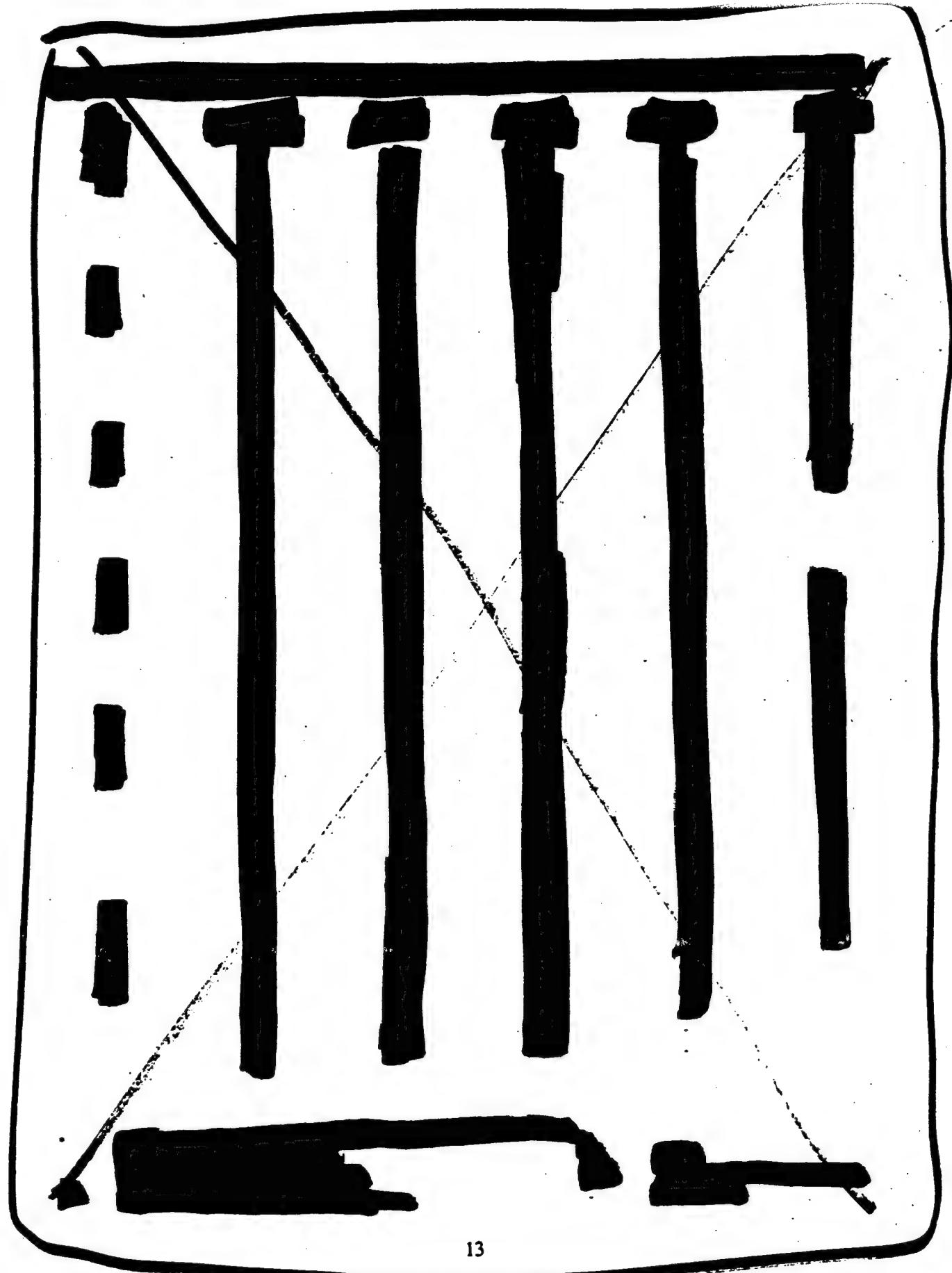
2.3.2

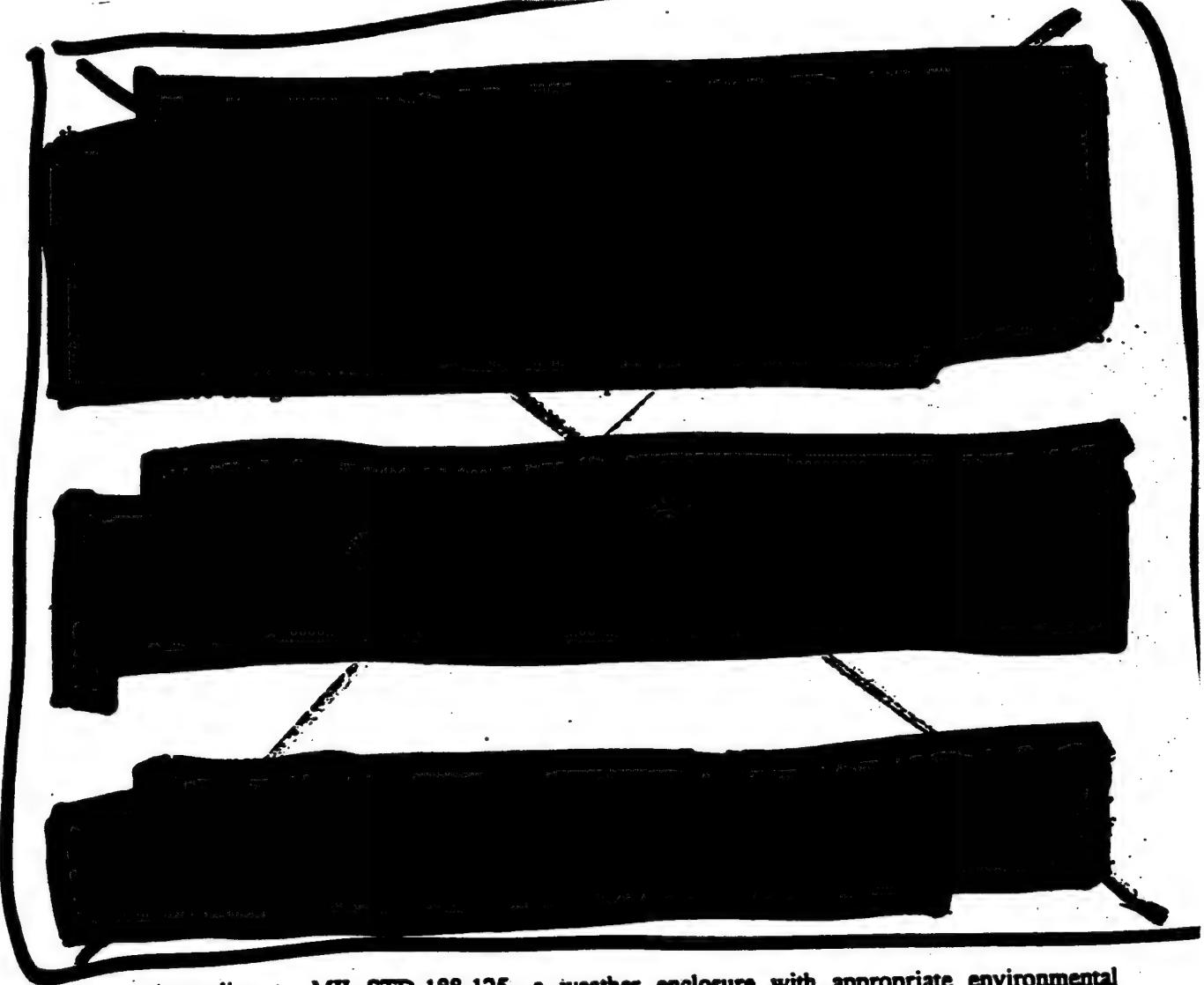
2.3.3



3.3 COMPARISON WITH MIL-STD-188-125 REQUIREMENTS.

Although not part of the request for assistance, it is useful to compare the results obtained in these door tests with the (attenuation) requirements specified in MIL-STD-188-125 (reference 4). While this comparison has no affect on the requirements for the doors on this project, such a comparison provides data for use in DNA's HEMP Standards and Technology program. The reader is cautioned, however, that results of MIL-STD-285/NSA 65-6 type tests can not be compared directly with results obtained in a MIL-STD-188-125 test since there are differences in the test methodology between the two types of tests.

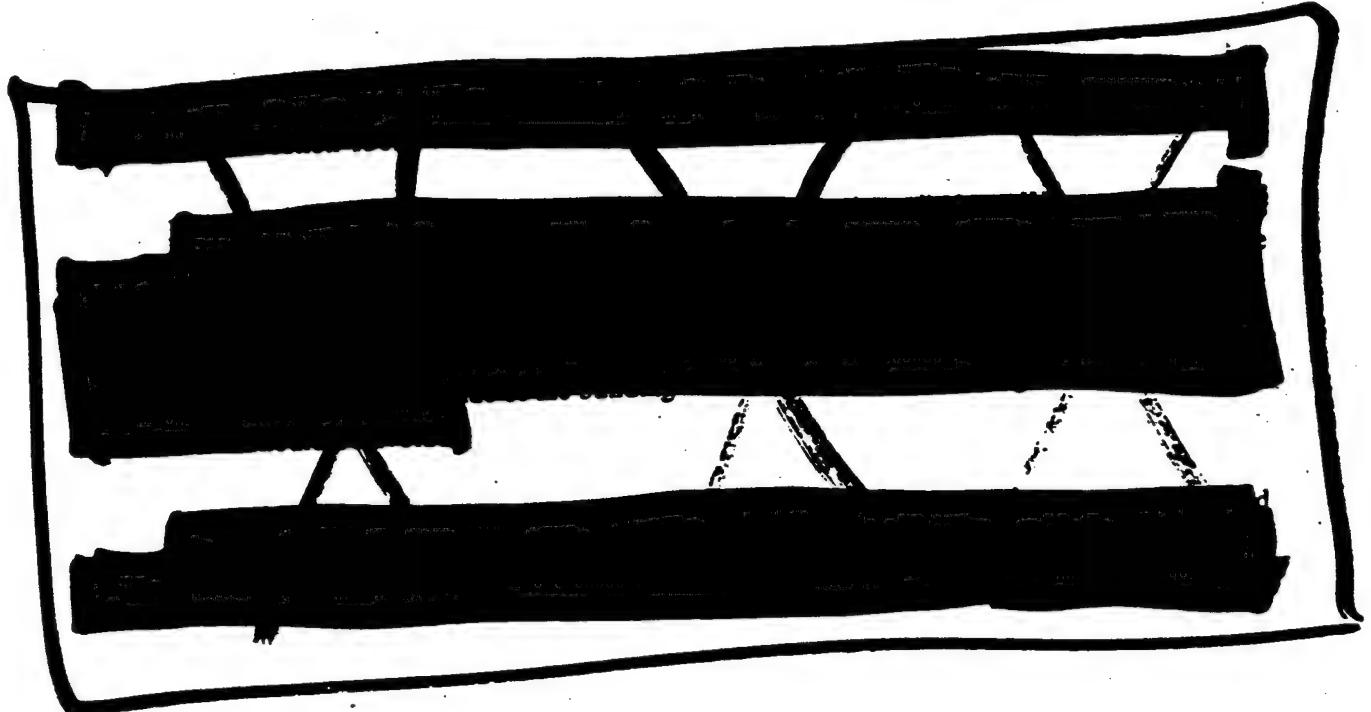




According to MIL-STD-188-125, a weather enclosure with appropriate environmental controls, is required to protect exterior shield doors from corrosion and exposure to blown dust and other natural elements.

3.4 RECOMMENDATIONS

Based on the results of four different tests on the facility doors—(1) the acceptance test, (2) August 22, 1991 tests, (3) the September 19, 1991 tests, and (4) the tests reported herein

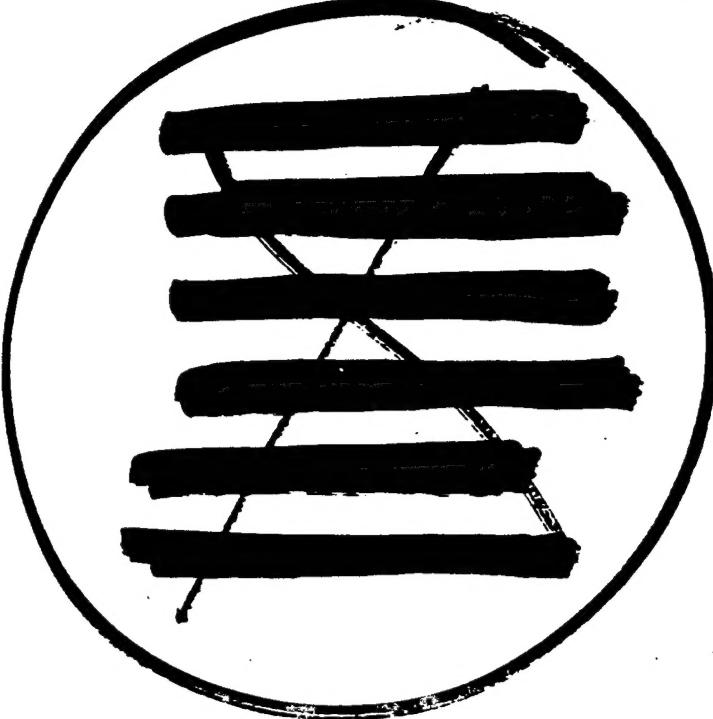


REFERENCES.

1. Facility HEMP protection system specification: "Section 13094 HEMP Shielded Enclosure, Welded Type," [REDACTED]
2. Letter Report: "MIL-STD-285 Shielding Effectiveness Test Procedures Conducted and Test Results" [REDACTED]
3. "Military Standard—Attenuation Measurements for Enclosures, Electromagnetic Shielding, for Electronic Test Purposes, Method of," MIL-STD-285, 25 June 1956.
4. "Military Standard—High-Altitude Electromagnetic Pulse (HEMP) Protection For Ground-Based C⁴I Facilities Performing Critical, Time-Urgent Missions for Common Long-Haul/Tactical Communication Systems," MIL-STD-188-125, 26 June 1990.

APPENDIX A

TEST DATA SHEETS FROM THE AUGUST 22, 1991 TEST



Pages 18-23
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entirety.

APPENDIX B

TEST DATA SHEETS FROM THE SEPTEMBER 19, 1991 TEST [REDACTED]

[REDACTED]

TESTED BY: ADVANCED MEASUREMENTS SYSTEMS, INC.



Pages 25-31
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entirety.

APPENDIX C

TEST DATA SHEETS FROM THE OCTOBER 3-4, 1991 TEST OF THE [REDACTED]

[REDACTED] SHIELDED DOORS.

TESTED BY: DNA/MISSION RESEARCH CORPORATION



*Pages C
1-10 removed
in their entirety.*